(1) The results confirm those of Schultze that isolated pieces from the center of the heart can contract in sea water. (2) They have established the new facts, (*a*) that in the intact animal the heart may sometimes beat *from the center towards both ends;* also, (*b*) that when the heart is tied near the center, the *isolated pieces may sometimes beat from the center towards the ends;* and (*c*) in *such pieces* there may even be a *regular alteration in the direction of the heart-beat.* These last results will probably necessitate a complete change in our conception of the character of the Ascidian heart-beat.

This is a proper place to record the occurrence of *Branchiostoma Californiense* at San Pedro, hitherto not known farther north than San Diego. About a dozen specimens were dredged during the summer, some in the inner harbor, and others outside but near its mouth.

It may also be noted here that the Point Loma blind fish, *Typhlogobius Californiensis,* hitherto not reported north of San Diego, was found at San Pedro. At White's Point it was found in holes in the soft rock and under stones; while during the *Peridinium* visitation a considerable number of specimens were cast ashore, some alive and others dead, along the breakwater at San Pedro.

WM. E. RITTER.
UNIVERSITY OF CALIFORNIA,
BERKELEY, October 29, 1901.

SCIENTIFIC BOOKS.

A Treatise on Hydraulics. By HENRY T. BOVEY, M. Inst. C.E., LL.D., F.R.S.C. Second edition, rewritten. New York, John Wiley and Sons. 1901. Pp. xviii + 583. Figs. 330. Price, $5.00.

The second edition of Dr. Bovey's well-known text-book is practically a new work, having been largely rewritten, rearranged and nearly doubled in extent; forming a very important and valuable addition to the literature of engineering education. It contains 583 pages and 330 figures, as against 337 and 196, respectively, in the first edition; embodying also some improvements in mechanical execution, such as the substitution of clear-cut line engravings for the few (but hazy) half-tones illustrating certain water-meters in the first edition, and the use of bold-faced type for important formulæ. Being printed on thinner paper the present volume possesses no more weight or bulk than the earlier book.

As in the earlier edition, the statements of many numerical examples, with their answers, are placed at the end of each chapter, and these have been greatly increased in number (*e. g.,* at the end of Chapter I. we find 106 examples as against 76 in the first edition); but a new and special feature in this respect consists in the insertion, in the body of the text in connection with each topic, of numerical examples fully worked out in all their details. This added feature will be heartily welcomed by engineering students possessing only average mathematical ability, and hence needing careful guidance in the principles of correct numerical substitution.

Among additions to the subject-matter the following are prominent:

A description of the elaborate apparatus in the Hydraulic Laboratory of McGill University, for experimentation with jets of water (as to coefficients of efflux, form of jets and impact of jets on vanes and cups of various shapes); with methods of use and results obtained.

An illustrated abstract (ten pages of fine print) of Bazin's papers in the *Annales des Ponts et Chaussées* on experiments with weirs; including the phenomena of depressed, drowned and adhering nappes.

In connection with flow in pipes, the formulæ of Darcy, Hagen, Thrupp, Reynolds, Lévy, Vallot, Manning, Tutton, Flamant, Foss and Lampe.

Many of the results obtained by Mr. C. H. Tutton in 1896 in his careful and extended collation, and logarithmic plotting, of the elements of some 1,000 recorded experiments on the flow of water in pipes; with diagrams and formulæ.

For uniform flow in open channels, the formulæ of St. Venant, Bazin, Manning, Tutton, Humphreys and Abbot, and Gauckler; and extensive tables of the coefficients to be employed with the formulæ of Bazin, Ganguillet and Kutter and Manning.

A practically new and well-illustrated chapter (Chapter IV., of 25 pages and 22 figures), on hydraulic rams, presses, accumulators and water-pressure engines.

Some of the results of Freeman's experiments with nozzles, jets and hose for fire-engines.

Considerable extra matter in the theoretical treatment of vertical water-wheels and turbines.

A new chapter (of 30 pages and 22 figures) devoted exclusively to centrifugal pumps; giving much practical detail as well as theoretical treatment.

References (on pp. 168 and 206) to the recent experiments made at Detroit by Prof. G. S. Williams and others on the flow of water in pipes; as regards the loss of head due to curves in pipes from 12 to 30 inches in diameter, and the distribution of velocity in the cross-section. (See *Proc. Am. Soc. Civ. Engineers* for May, 1901, and later discussion.)

It is seen that much of the above added matter has to do with the practical and experimental side of the subject; and in this connection it is perhaps to be regretted, from a practical standpoint, that the author had not omitted a large part of the theoretical treatment of unimportant and nearly obsolete forms of vertical water-wheels, substituting therefor some account of recent modern turbines and their appurtenances such as the wheels at Niagara Falls and the prominent American makes known as 'Victor,' 'New American,' 'Hercules,' 'McCormick,' etc.; with a chapter giving methods and results of tests of efficiency.

Criticism and comment on a few incidental points may perhaps be permitted. 'American' readers of the book may need to be reminded that the gallon employed in the numerical examples (gallon of water) is the Imperial gallon of 271 cubic inches used in England and weighing 10 pounds. The weight of the United States gallon (8.32 lbs.) is not mentioned in the work, although its volume (231 cubic inches) is given in the preliminary table of 'Useful Constants.'

As to the compressibility of water (see p. 5) and corresponding modulus of elasticity of volume, the author might have mentioned the experiments described by Mr. Stillman on p. 236 of *Engineering News* of October 4, 1900. In these water was subjected to a pressure of 65,000 pounds per square inch, with a resulting reduction of volume of 10 per cent.

In the treatment of problems involving the steady flow of water in branching pipes the reader might have been reminded of the great saving in time and trouble that can be accomplished by the use of diagrams of friction-heads in pipes, such as are given in Collignon's 'Hydraulique' and in Coffin's 'Graphical Solution of Hydraulic Problems,' and incidentally in engineering periodicals. (On p. 415 of the *Engineering Record* for November 3, 1900, Mr. J. H. Gregory presents such a diagram; which, having a logarithmic basis, covers a wide range of values both of diameter of pipe and friction-heads.) Although many results of experiments with pipes are stated in graphic form (Tutton) in the work before us, the diagrams are not arranged with a view to giving aid in the solution of problems. Since only the logarithms, and not the quantities themselves, are figured along the edges of these diagrams, the latter are not available for ready use.

There would seem to be some inconsistency in presenting the numerical example of p. 161 as apparently an illustration of the theory given in article 12 ('Pressure Due to Shock') of p. 160. In article 12 the closing of the stop-gate is instantaneous, and the kinetic energy of the moving water is absorbed by the elastic compression of the water itself (the pipe being supposed fixed and its possible distension neglected). In the numerical example, however, the stop-gate is gradually closed and is supposed to be handled in such a way as to make the retardation of the cylinder of water *uniform;* and as the kinetic energy of the great mass of the water is gradually given up a

nearly equal amount of kinetic energy is generated in the smaller mass passing (with high velocity) through the narrowing sectional area under the edge of the gate. Here the compression of the water is not considered, the pressure being small; as is shown by the fact that neither the modulus of elasticity (of volume) nor the velocity of sound enters the equation employed. It would have been well to remind the student at this point that in the gradual closing of a stop-gate, if the motion of the gate is uniform the rate of retardation of the water can not be uniform, and that the pressure induced just behind the gate is consequently variable and reaches a maximum value which may be many times as great as the average pressure (which average is equal to the pressure produced when the gate is so managed as to make the retardation uniform, the whole time of closing remaining unchanged).

As to the discussion of the impact of a jet upon a flat plate or vane (p. 378), one cannot help thinking that it would have been preferable to substitute for this rather lengthy and involved treatment (where the reader must be uncertain whether the plate is furnished with borders parallel to the paper or not) the simple and direct analysis given by Rankine in Case V. of § 144 of his 'Steam Engine and Other Prime Movers' (also given by Cotterill).

On page 500, in the theory of the turbine, the term 'velocity of flow' is used in a sense entirely different from that specially defined on page 498; and on the same page (500) obscurity of language results from the apparent statement that impulse equals momentum (instead of change of momentum).

The author is evidently (p. 96) of the same opinion as Collignon (see 'Hydraulique,' p. 146) when he designates as 'gratuitous' the assumption that in the case of a flat-topped weir the flow adjusts itself to such a depth on the weir as to bring about a maximum discharge. Several authors have noted that experiment gives results not very wide of this relation. Unwin (p. 472, article 'Hydromechanics, Encyclop. Brit.) is rather non-committal on this point, though giving the same analysis; whereas Mr. J. P. Frizell (see *Engineering News* of September 29, 1892) is plainly of the opinion that the flow should theoretically adjust itself to a maximum discharge.

I. P. CHURCH.

Dragons of the Air, an Account of Extinct Flying Reptiles. By H. G. SEELEY, Professor of Geology in King's College, London. London, Methuen & Co.

When so accomplished a student of extinct life as is Professor Seeley writes in so pleasing a way as he has of a group of animals to which he has devoted many years of study, the results can only be happy. Divested so far as is possible of technicalities, accurate in statement, lucid in presentation, and enriched by patiently gathered facts from many sources, his present work upon the 'Dragons of the Air' summarizes for the paleontologist, as well as for the general reader, about all that is known of those strange fossil reptiles called pterodactyls or ornithosaurs. The book contains a discussion of reptilian characters, the range and distribution of pterodactyls, a review of the known forms, and a thorough comparison of them with other vertebrated animals, part by part, a history of their development, inferences as to their habits, and conclusions as to their place in the animal kingdom.

It is illustrated by many figures and plates of the bones or skeletons of pterodactyls and allied animals, and by many restorations of the creatures as the author and others have conceived them. In a few words, the work, while popularized, is a critical review of this extinct order of reptiles from many sides, interesting because of the strangeness of the animals and valuable to the student of vertebrate morphology, as well as to the geologist.

However, with the fullest respect for the author's anatomical erudition and admitting the force of his reasoning in many cases, the present writer can not always agree with his conclusions. To review them all would be out of place here; the curious reader may expect a wider discussion elsewhere. Many of the bird-like or mammal-like characters which he sees in the pterodactyl, Professor